

Ascidians of Tangsa and its Adjacent Waters in Korea Strait

Boon Jo Rho, Byung Lae Choe*, Jun-Im Song and Young Ja Lee

(Department of Biological Science, Ewha Womans University, Seoul, 120-750, Korea;

*Department of Biology, Sung Kyun Kwan University, Suwon, 440-746, Korea)

ABSTRACT

The ascidians specimens were collected from Tangsa and its adjacent waters in Korea by scuba divers during the period from 1994 to 1999. They were identified into 30 species which are reported for the first time in Tangsa. Out of them one species, *Molgula hozawai*, was turned out to be new to the Korean fauna, and six species, such as *Eudistoma illotum*, *Symplegma connectans*, *Boltenia transversaria*, *Microcosmus nultitentaculatus*, *Pyura squamata* and *Molgula hozawai*, were newly recorded in Chundo Island and Geojedo Island, which are influenced by warm waters of the Kuroshio Current.

Key words: Taxonomy, ascidians, Tangsa, Korea

INTRODUCTION

This work was carried out as a part of the systematic studies on the marine fouling invertebrates in Korea. The studies on the ascidian fauna in Chundo Island and Geojedo Island and its adjacent waters have been done by Rho *et al.* in 1996 and by Rho and Park in 1998.

The ascidian specimens were collected from Tangsa and its adjacent waters of the Korea Strait (129° 27'E, 35° 22'N) during the period from July 1994 to June 1999.

307 ascidian individuals (colonies) were collected and preserved in 5% neutral formalin for this

This asterisk (*) indicates the new records to the Korean fauna.

The double asterisks (**) indicate the newly recorded species in Korean waters influenced by warm Kuroshio Current.

study. The ascidian species occurring in the collection are given in the Table 1. They are well-known species in the warm water environments. The descriptions of these species were done by Rho (1966, 1971, 1975, 1995), Rho and Huh (1984), Rho and Lee (1989, 1991), Rho *et al.* (1996), and Rho and Park (1998). Out of them, *Molgula hozawai*, is newly recorded in Korean waters (see Table 1).

The redescrptions and illustrations on new records in Korea and the previous records on the already known species in Korea are given.

MATERIALS AND METHODS

All of the specimens were collected through a quantitative sampling method at different depths, from the intertidal zone to the maximum depths of 20 meters.

The collection of ascidians was done along the coastal sea of Tangsa and its adjacent waters during the period from July 1994 to June 1999.

The specimens were collected mostly from the underside of rocks and solid substratum in the intertidal zone. The scuba or skin diving were sometimes used in the vicinity of Tangsa and its adjacent waters. The samples were preserved in 5% neutral formalin after narcotization with menthol. The specimens were soaked in a softening solution for 24 hours to examine the internal structures. This solution was composed of 1% chromic acid and 5% acetic acid in a ratio 1: 10. And then, they were transferred into a second solution (1% chromic acid) for softening of tunics.

The identification was done on the basis of the external and internal morphological characters, which were proposed by Van Name (1945), Kott (1985) and Nishikawa (1990, 1991). For the purpose of observation, the spicules and the siphonal armatures, were gold-coated with ion sputter (JFC-1100) at 1.0 KV, 50 mA for 10 minutes, and photographed with JSM 35CF-type scanning electron microscope.

The specimens examined here are deposited in the Department of Biological Science, Ewha Womans University.

SYSTEMATIC ACCOUNTS

Taxonomic notes

Family Polyclinidae Milne Edwards, 1842 만두멍게과

1. *Aplidium pliciferum* (Redikorzev, 1927) 만두멍게

Previous records in Korea. Rho, 1966; 1971; 1975; Rho and Huh, 1984; Rho and Lee, 1991; Rho, 1995; Rho, Choe and Song, 1996; Rho and Park, 1998.

Material examined. 3 colonies. 15 Feb. 1995; 16 colonies, 27 Jul. 1995, 0-3 m depths; 3 colonies, 3 Jul. 1996.

Family Didemnidae Verrill, 1871 흰등이멍게과

2. *Didemnum (D.) moseleyi* (Herdman, 1886) 흰등이멍게

Previous records in Korea. Rho, 1971; 1975; Rho and Huh, 1984; Rho and Lee, 1989; 1991; Rho, 1995.

Material examined. 5 colonies, 27 Jul. 1995, 1 m depth; 3 colonies, 3 Jul. 1996.

3. *Didemnum (P.) aspiculatum* Tokioka, 1949 방패흰등이멍게

Previous records in Korea. Rho, 1975.

Material examined. 4 colonies, 27 Jul. 1995, 4 m depths; 1 colony, 16 Jul. 1994, (Ulgi).

Family Polycitoridae Michaelson, 1924 회색곤봉멍게과

****4. *Eudistoma illotum* (Sluiter, 1898) 일로툼멍게**

Previous records in Korea. Rho, 1971; 1975; Rho and Huh, 1984; Rho and Lee, 1989.

Material examined. 1 colony, 16 Jul. 1994, (Ulgi); 2 colonies, 27 Jul. 1995, 1 m depth.

Family Ascidiidae Herdman, 1880 대추멍게과

5. *Ascidia sydneyensis* Stimpson, 1855 꾸러기대추멍게

Previous records in Korea. Rho, Choe and Song, 1996.

Material examined. 5 inds., 16 Jul. 1994, (Ulgi), 3–6 m depths; 10 inds., 15 Feb. 1995; 5 inds., 2 Feb. 1997; 1 ind., 1 Jul. 1997.

6. *Ascidia gemmata* Sluter, 1885 흑대추멍게

Previous records in Korea. Rho, 1975; Rho and Huh, 1984; Rho, Choe and Song, 1996.

Material examined. 3 inds., 15 Feb. 1995, 10–12 m depths; 1 ind., 27 Jul. 1995; 1 ind., 2 Feb. 1997.

7. *Ascidia zara* Oka, 1935 자라대추멍게

Previous records in Korea. Rho, Choe and Song, 1996.

Material examined. 1 ind., 2 Feb. 1997.

Family Corellidae Lahille, 1888 안장멍게과

8. *Rhodostoma turcicum* (Savigny, 1816) 철면조안장멍게

Previous records in Korea. Rho, 1971; 1975; Rho and Huh, 1984; Rho and Lee, 1989.

Material examined. 1 ind., 16 Jul. 1994, (Ulgi) 2 m depths; 1 ind., 15 Feb. 1995, 5 m depths; 1 ind., 10 Jan. 1998, 4–6 m depths.

Family Botryllidae Verrill, 1871 판멍게과

9. *Botryllus tuberatus* Ritter et Forsyth, 1917 국화판멍게

Previous records in Korea. Rho, 1966; 1971; 1975; Rho and Huh, 1984; Rho and Lee, 1989; 1991.

Material examined. 2 colonies, 16 Jul. 1994, (Ulgi) 4 m depths; 1 colony, 27 Jul. 1995, 1 m depth; 3 colonies, 4 Feb. 1996; 2 colonies, 3 Jul. 1996.

10. *Botrylloides violaceus* Oka, 1927 보라판멍게

Previous records in Korea. Rho, 1966; 1971; 1975; Rho and Huh, 1984; Rho and Lee, 1989; 1991; Rho, 1995; Rho, Choe and Song, 1996.

Material examined. 1 colony, 27 Jul. 1995, 0-1 m depths; 1 colony, 4 Feb. 1996.

Family Styelidae Sluiter, 1895 미더덕과

11. *Polyzoa pacifica* Tokioka, 1951 태평양멍게

Previous records in Korea. Rho, 1971; Rho and Huh, 1984; Rho and Lee, 1989; 1991.

Material examined. 5 inds., 16 Jul. 1994, (Ulgi) 3 m depths.

****12. *Symplegma connectans* Tokioka, 1949** 새공멍게

Previous records in Korea. Rho and Huh, 1984; Rho and Lee, 1989; 1991; Rho, 1995.

Material examined. 1 colony, 16 Jul. 1994, (Ulgi) 4 m depths; 1 colony, 3 Jul. 1996.

13. *Cnemidocarpa clara* (Hartmeyer, 1906) 긴위멍게

Previous records in Korea. Rho, 1966; 1975; Rho and Huh, 1984; Rho and Lee, 1991; Rho and Park, 1998.

Material examined. 3 inds. 16 Jul. 1994, (Ulgi) 2 m depths; 1 ind. 2 Feb. 1997.

14. *Cnemidocarpa irene* (Heller, 1878) 유두멍게

Previous records in Korea. Rho, 1971; Rho and Huh, 1984; Rho and Lee, 1989; 1991; Rho and Park, 1998.

Material examined. 1 ind., 27 Jul. 1995, 1 m depth.

15. *Styela clava* Herdman, 1881 미더덕

Previous records in Korea. Rho, 1966; 1971; 1975; Rho and Huh, 1984; Rho and Lee, 1989; 1991; Rho, 1995; Rho, Choe and Song, 1996.

Material examined. 1 ind., 16 Jul. 1994, (Ulgi); 5 inds., 15 Feb. 1995, 2-10 m depths; 1 ind., 27 Jul. 1995, 3 m depths; 15 inds., 4 Feb. 1996, 4-7 m depths; 2 inds., 3 Jul. 1996; 2 inds., 2 Feb. 1997.

16. *Styela canopus* (Savigny, 1816) 두줄멍게

Previous records in Korea. Rho, 1966; 1975; Rho and Huh, 1984; Rho and Lee, 1989; 1991; Rho, 1995; Rho, Choe and Song, 1996.

Material examined. 1 ind., 15 Feb. 1995, 9 m depths; 1 ind., 27 Jul. 1995, 9 m depths.

17. *Styela plicata* (Lesueur, 1823) 주름미더덕

Previous records in Korea. Rho and Lee, 1991; Rho, 1995; Rho, Choe and Song, 1996.

Material examined. 1 ind., 15 Feb. 1995, 5 m depths; 2 inds., 10 Jan. 1998, 4-6 m depths.

18. *Styela tokiokai* Nishikawa, 1991 토끼오카미더덕

Previous records in Korea. Rho, 1971; 1975; Rho and Huh, 1984; Rho and Lee, 1991; Rho and Park, 1998.

Material examined. 12 inds., 16 Jul. 1994, (Ulgi); 5 inds., 15 Feb. 1995, 8-9 m depths; 6 inds., 4 Feb. 1996; 3 inds., 2 Feb. 1997; 1 ind., 10 Jan. 1998, 4-6 m depths.

Family Pyuridae Hartmeyer, 1908 멍게과

19. *Boltenia echinata* (Linnaeus, 1767) 침멍게

Previous records in Korea. Rho, 1975; Rho and Lee, 1989; 1991.

Material examined. 6 inds., 16 Jul. 1994, (Ulgi); 1 ind., 15 Feb. 1995, 10 m depths.

****20. *Boltenia transversaria* (Sluiter, 1904)** 가로줄멍게

Previous records in Korea. Rho, 1975; Rho and Huh, 1984; Rho, 1995.

Material examined. 5 inds., 15 Feb. 1995, 9 m depths.

****21. *Microcosmus multitentaculatus* Tokioka, 1953** 우주멍게

Previous records in Korea. Rho, 1971; 1975; Rho and Huh, 1984; Rho and Lee, 1989; 1991.

Material examined. 1 ind., 15 Feb., 1995, 12 m depths.

22. *Pyura lepidoderma* Tokioka, 1949 비늘가죽멍게 (Fig. 1. A-D)

Previous records in Korea. Rho, 1971; 1975; Rho and Huh, 1984; Rho and Lee, 1989; Rho, 1995; Rho, Choe and Song, 1996.

Material examined. 3 ind., 16 Jul. 1994, (Ulgi) 3 m depths; 3 inds., 15 Feb. 1995, 10 m depths; 1 ind., 27 Jul. 1995, 6 m depths; 3 inds., 4 Feb. 1996.

Remark. We compared the *Pyura lepidoderma* from Tangsa with known ones of *Pyura lepidoderma* from Chundo Island. The specimens from Tangsa are distinguished from Chundo Island specimens by the number, size, form and arrangement of the siphonal armatures (see Fig. 1).

23. *Pyura sacciformis* (v. Drasche, 1884) 매끈이멍게

Previous records in Korea. Rho, 1971; 1975; Rho and Huh, 1984; Rho and Lee, 1989; 1991; Rho, Choe and Song, 1996; Rho and Park, 1998.

Material examined. 17 inds., 16 Jul. 1994, (Ulgi) 3-12 m depths; 7 inds, 15 Feb. 1995, 3-9 m depths; 1 ind., 27 Jul. 1995, 5 m depths; 11 inds, 4 Feb. 1996, 5 m depths; 5 inds., 3 Jul. 1996; 4 inds. 2 Feb. 1997.

**** 24. *Pyura squamata* Hartmeyer, 1911** 네모가죽멍게

Previous records in Korea. Rho, 1971; Rho and Huh, 1984; Rho and Lee, 1991.

Material examined. 2 inds., 16 Jul. 1994, (Ulgi); 1 ind., 27 Jul. 1995, 3 m depths.

25. *Pyura vittata* (Stimpson, 1852) 끈멍게

Previous records in Korea. Rho, 1971; 1975; Rho and Huh, 1984; Rho and Lee, 1991; Rho, 1995.

Material examined. 3 inds., 16 Jul. 1994, (Ulgi); 7 inds., 15 Feb. 1995, 10 m depths.

26. *Herdmania mirabilis* (v. Drasche, 1884) 벼개멍게

Previous records in Korea. Rho, 1966; 1971; 1975; Rho and Huh, 1984; Rho and Lee, 1991; Rho, 1995; Rho, Choe and Song, 1996.

Material examined. 2 inds., 16 Jul. 1994, (Ulgi); 1 ind., 15 Feb. 1995, 10 m depths; 3 inds., 4 Feb. 1996; 1 ind., 3 Jul. 1996; 1 ind., 2 Feb. 1997.

27. *Halocynthia hispida* (Herdman, 1881) 개멍게

Previous records in Korea. Rho, 1971; 1975; Rho and Huh, 1984; Rho and Lee, 1989; 1991; Rho, Choe and Song, 1996; Rho and Park, 1998. .

Material examined. 28 inds., 16 Jul. 1994, (Ulgi); 6 inds., 15 Feb. 1995. 4 m depths; 3 inds., 4 Feb. 1996, 4-7 m depths; 6 inds., 2 Feb. 1997; 3 inds., 10 Jan. 1998, 4-6 m depths.

28. *Halocynthia roretzi* (v. Drasche, 1884) 멍게 (우렁챙이)

Previous records in Korea. Rho, 1966; 1971; 1975; Rho and Huh, 1984; Rho and Lee, 1991; Rho, 1995; Rho, Choe and Song, 1996.

Material examined. 3 inds., 16 Jul. 1994, (Ulgi); 2 inds., 15 Feb. 1995, 8-9 m depths; 5 inds., 4 Feb. 1996, 4-7 m depths; 1 ind., 3 Jul. 1996; 6 inds., 2 Feb. 1997; 1 ind., 10 Jan. 1998, 4-6 m depths.

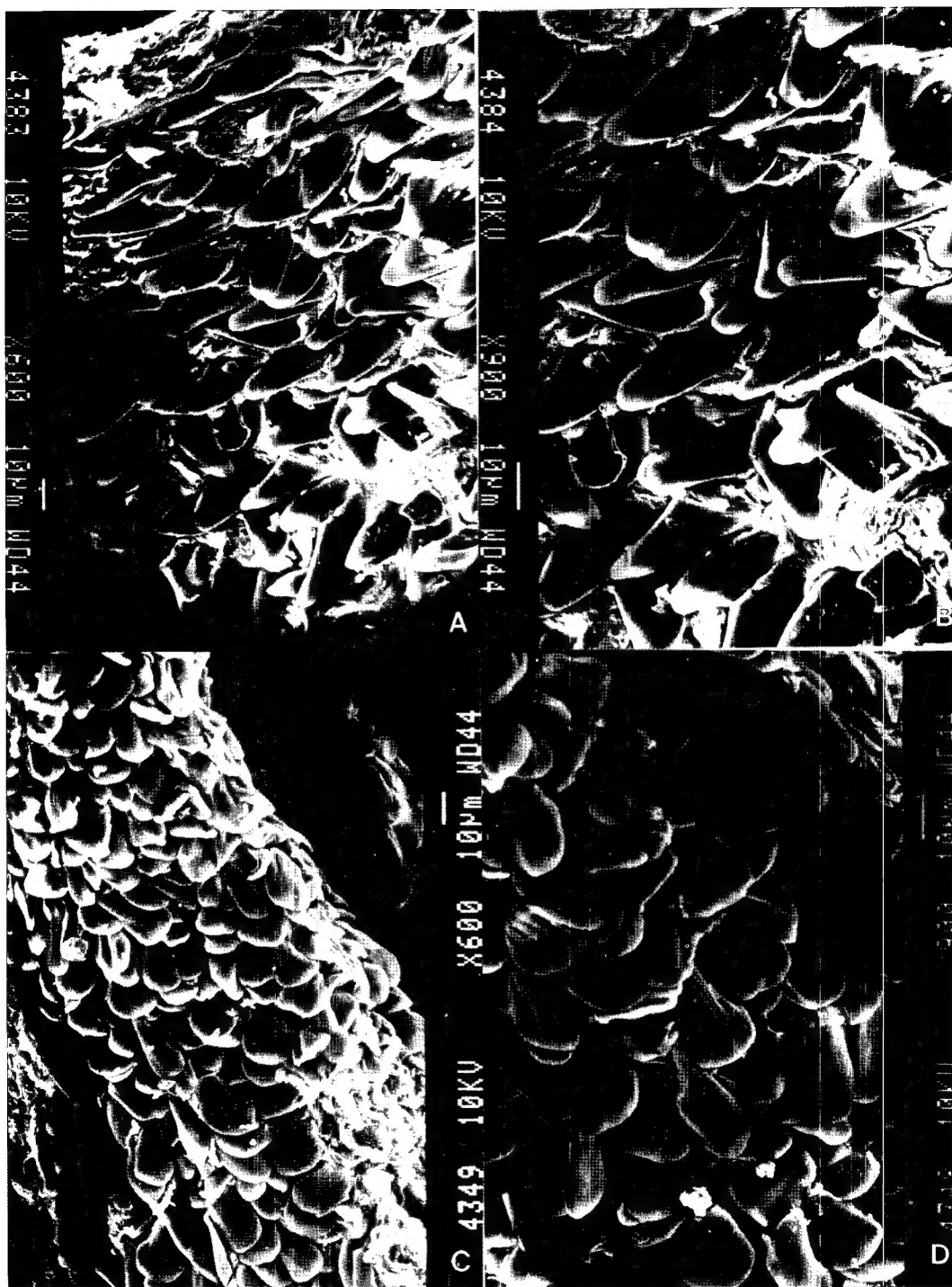


Fig. 1. *Pyura lepidoderma* Tokioka, 1949. A, B, Siphonal spines from Tangsa; C, D, Siphonal spines from Chundo Is. Scale bars: 6 mm (A, C), 9 mm (B, D).

Family Molgulidae Lacaze-Duthiers, 1877 가족빛멍게과

****29. *Molgula hozawai* Oka, 1932 주머니가족빛멍게 (신칭) (Fig. 2. A-E)**

Molgula hozawai Oka, 1932, p. 518, figs. A-B; 1935, p. 430, figs. 182; Nishikawa, 1981, p. 337, figs. 1-3, 5; 1991, p. 164.

Material examined. 2 inds., 16 Jul. 1994, (Ulgi) 10 m depths.

Description. Specimens 10 mm length, 9 mm width or 15 mm length, 12 mm width, globular, both siphons distinct in preservation, branchial siphons terminal, arterial ones nearly in middle of body, test very thin, densely coated with fine mud and long fine hair-like fibers, and partly adhered with other material. When removed its fine covering of mud, rather thick and grayish white in color, and very thin in test itself, flexible and transparent.

Body wall also thin, with conspicuous short muscle, radiating from siphons, and consists of fine muscle fibers, all over mantle body, thicker muscle bundles on siphons, and usually short bands of circular series confined to median part of upper anterior of body. Margin of both apertures with 6 lobes, forming funnel-like structures within siphon. Tentacles 19-20, alternately arranged with primary and secondary branching. Ciliated groove L or U-shaped slit. Dorsal lamina tall and plain.

Branchial sac with seven folds, internal longitudinal vessels quite close, arranged as follows:

10 mm long specimen - L.D. 0 (4) 0 (4) 0 (5) 0 (5) 0 (6) 0 (6) 0 (3) 0 V.

R.D. 0 (3) 0 (5) 0 (5) 0 (6) 0 (5) 0 (5) 0 (3) 0 V.

15 mm long specimen - L.D. 0 (6) 0 (7) 0 (8) 0 (7) 0 (7) 0 (6) 0 (4) 0 V.

R.D. 0 (5) 0 (7) 0 (8) 0 (7) 0 (7) 0 (6) 0 (5) 0 V.

Only one infundibulum inserted between thicker transverse vessels in the ventral side of branchial sac, and stigmata at apex of infundibulum form single short spiral or divided into two submits, no longitudinal vessels exist between folds, entirely straight stigmata, and often some quite irregular ones.

Stomach with largely swollen, liver wholly smooth externally, long intestine, primary and secondary intestines lying quite close to each other except near bending, strongly curved, rectum curves upwards to base of atrial siphon, and anus smooth-edged.

Gonads fully matured, rather long and wide ovary, one on each side of body, their upper parts, consisting of eggs, enclosed in lower testicular parts which have a radiating structure (see Fig. 2). Left gonad arranged anterior part of secondary intestinal loop close against intestine and right ones close above curved ranal sac.

Ranal sac arranged horizontally, its upper edge with somewhat curve line, both gonads largely circular or oval somewhat concave discs, testicular follicles arranged round all side of body, short oviduct seen near upper edge of ovarian part, and male genital aperture situated very close to aperture of short oviduct and common sperm duct project from the mesial face of gonad.

Remarks. The morphological characters of this species correspond so closely to those of *Molgula hozawai*, described by Nishikawa (1991) from Japanese waters in which the number of internal longitudinal vessels is 4-7 in larger specimen (3-6 in small ones), and the gonad is situated in the loop. However, the Korean specimens are somewhat different from Japanese specimen, Korean specimens have wider open secondary gut loop, and the left gonad is further apart from the secondary intestine, and the numerous testicular follicles are gathered at the terminal of the ovary.

This species is described for the first time in Korean waters.

Distribution. Korea (Ulgi and Aninjin), Japan (Mutsu Bay, Wakasa Bay, Kii Peninsula, Osaka bay, Kagoshima Bay).

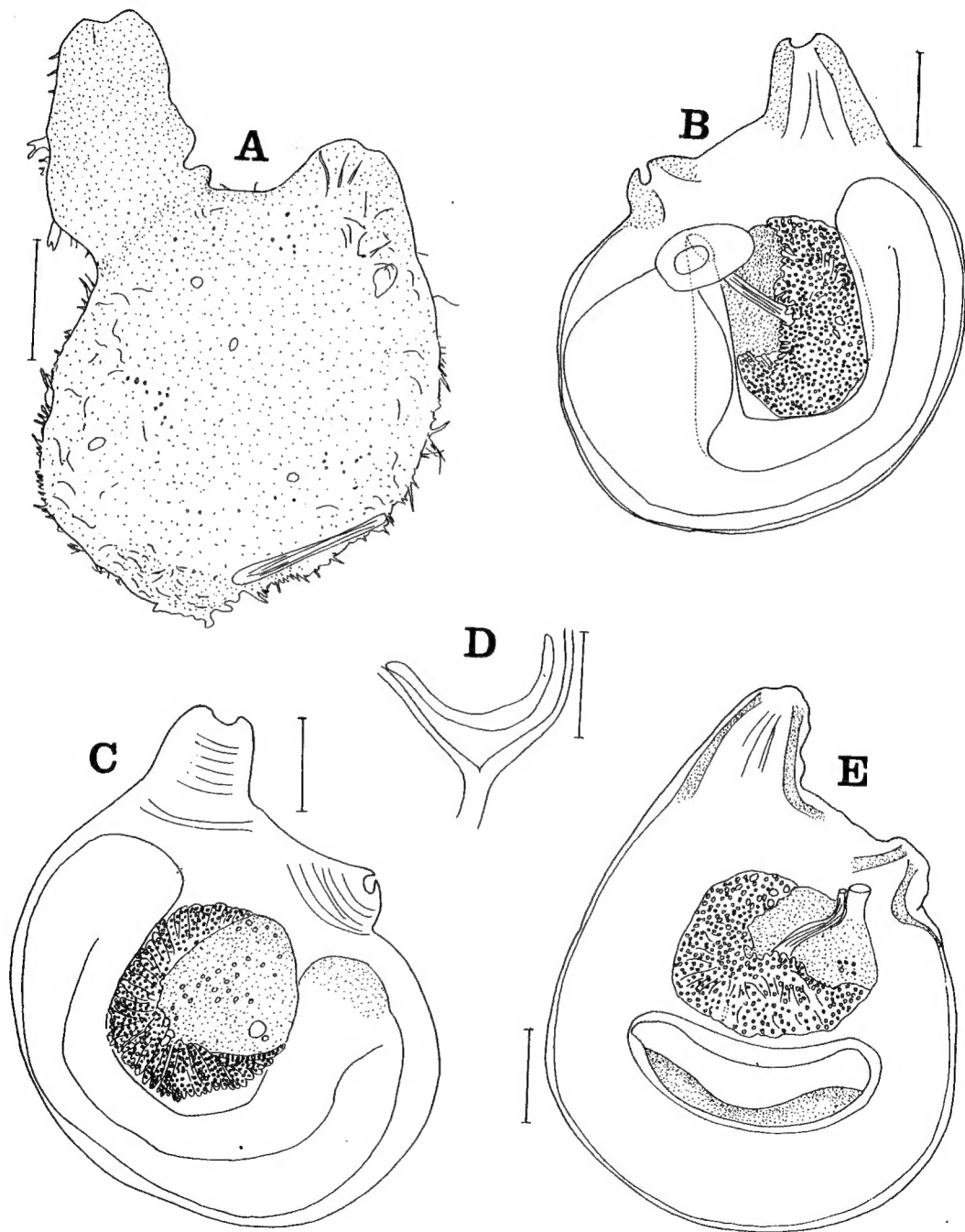


Fig. 2. *Molgula hozowai* Oka, 1932. A, Left side; B, Left side, inner side; C, Right side of body surface; D, Ciliated groove; E, Right side, inner side. Scale bars: 0.5 mm (D), 2 mm (B, C, E), 3 mm (A)

30. *Molgula tectiformis* Nishikawa, 1991 미끈가죽빛멍게

Molgula calvata Sluiter, 1904, p. 116 Taf. 14, figs. 7-10.

Molgula calvata, Kott, 1964, p. 144; 1985, p. 369, figs. 183; Miller, 1975, p. 322, fig., 101; Rho and Lee, 1991, p. 206, pl. 9c-d. fig. 5.

Molgula tectiformis Nishikawa, 1991, p. 160, fig. 39; Rho and Park, 1998, p. 183.

Material examined. 1 ind., 16, Jul. 1994, (Ulgi); 2 inds., 15 Feb, 1995, 10 m depths; 1 ind., 2 Feb. 1997, 10 m depths.

Description. Larger specimens 15 mm length, 20 mm width, nearly globular, more or less flattened laterally, both siphons almost sessile, and situated terminally. Body surface nearly completely covered by large or small prominences, minute papillae as well as partly such as bryozoans, bivalves and *Didemnum* sp. and also short fine hair like fiber on the apparent attachment side. Specimens in 10 mm or shorter, surface nearly smooth and usually covered wholly by short hair like fibers.

Test rather thick, tough leathery, translucent (in 15 mm long) or more or less transparent (in 10 mm small long) and milky white, fleshy pink to pale purplish brown, mantle body seen clearly through test. Both siphons distinct, branchial terminal and atrial subterminal, both aperture lobed with serrated margin, mantle musculature consist of network of fine muscle fibers densely and evenly distributed over nearly entire mantle body with 10 or more thick muscle bundles radiation from siphons, extending ventral to anterior one-third of body. Tentacles 22-30, various sizes and branched. Ciliated grooves C-shaped with open usually toward left. Seven branchial folds on each side, no longitudinal vessels in the interspaces, each fold represented by only 2 longitudinal vessels, which lie near crest. Two infundibulata inserted between thicker transverse vessels and stigmata nearly straight exclusively between longitudinal rows. Dorsal lamina smoothly edged, visceral mass occupying for more than posterior half of mantle body, liver plicated on cardiac surface but wholly papillated on pyloric, first intestinal loop very deep and narrow, second loop rather deep but rather widely opened, rectum short, parallel, fused to anterior end of oesophagus, and opening roughly at level of oesophalngeal opening.

Single gonad on each side, left on fills second intestinal loop completely, right ones lying on anterior and parallel to large renal sac, gonads fully matured, elongated, oval ovary, filled with eggs and with terminal oviduct.

Thick mass of testicular follicles cover mesial surface of ovary, in some specimens, masses situated on wide central part of ovary, fine vas deference usually passing along testis between its anterodorsal corner, short upright duct on ovary, and duct situated apart from oviduct.

Remark. This species is the most closely related to *Molgula calvata* described by Kott (1985) from Australia, especially in terms of its gonads, deep body and vas deference opening along the surface of the ovary. However, our specimens differ from *M. calvata* (see Kott, 1985), which has the dendritic testicular lobe in the body wall around its distal end extending over the sides of ovary. Also *M. tectiformis* by Nishikawa (1991), collected from Japanese waters present similarities to our specimens in its form of the swollen stomach, the gut forms and the position and structure of gonads. However, *M. tectiformis* (see Nishikawa, 1991) differs from ours, because it has single vessel on some folds. Korean specimens have always two vessels on branchial sac.

Distribution. Korea (Hodo Is., Samchönp'o, Ssanggeun, Yeoch'a, Chundo Is., Tangsa (Korea

Table 1. Ascidians collected from Tangsa and its Adjacent waters (Ulgi), and their Geographical distribution.

| Species | Localities Collection date | Tangsa | | | | | Adjacent waters (Ulgi) 16 Jul. '94 | Depth range (m) | Geographical distribution | | |
|----------------------------------|----------------------------------|----------------|----------------|---------------|---------------|---------------|---|-----------------------|---------------------------|----------------|----------------|
| | | 15 Feb. '95 | 27 Jul. '95 | 4 Feb. '96 | 3 Jul. '96 | 2 Feb. '97 | | | 1 Jul. '97 | 10 Jan. '98 | Chundo Is. '96 |
| Polyclinidae | | | | | | | | | | | |
| <i>Aplidium pliciferum</i> | 3 | 16 | | 3 | | | | 0-3 | + | + | |
| Didemnidae | | | | | | | | | | | |
| <i>Didemnum (D.) moseleyi</i> | | 5 | | 3 | | | | 0-1 | + | + | |
| <i>Didemnum (P.) aspiculatum</i> | | 4 | | | | | 1 | | + | + | |
| Polycitoridae | | | | | | | | | | | |
| <i>Eudistoma illotum</i> | | 2 | | | | | 1 | 0-1 | | + | |
| Asciidae | | | | | | | | | | | |
| <i>Ascidia sydneyensis</i> | 10 | | | | 5 | 1 | 5 | 3-12 | + | + | |
| <i>Ascidia gemmata</i> | 3 | 1 | | | 1 | | | 10-12 | + | + | |
| <i>Ascidia zara</i> | | | | | 1 | | | | + | + | |
| Corellidae | | | | | | | | | | | |
| <i>Rhodossoma turcicum</i> | 1 | | | | | | 1 | 2-6 | + | + | |
| Botyllidae | | | | | | | | | | | |
| <i>Botyllus tuberosus</i> | | 1 | 3 | 2 | | | 2 | 1-4 | + | + | |
| <i>Botylloloides violaceus</i> | | 1 | 1 | | | | | 0-1 | + | + | |
| Styelidae | | | | | | | | | | | |
| <i>Polyzoa pacifica</i> | | | | | | | 5 | 3 | + | + | |
| <i>Symplegma connectans</i> | | | | 1 | | | 1 | 4 | | + | |
| <i>Enemidocarpa clara</i> | | | | | 1 | | 3 | 2-3 | + | + | |
| <i>Cnemidocarpa irene</i> | | 1 | | | | | | 0-1 | + | + | |
| <i>Styela clava</i> | 5 | 1 | 15 | 2 | 2 | | 1 | 2-7 | + | + | |
| <i>Styela canopus</i> | 1 | 1 | | | | | | 9 | + | + | |

Table 1. Continued.

| Species | Localities Collection date | Tangsa | | | | | Adjacent waters (Ulgil) | | Geographical distribution | | | |
|---|----------------------------------|----------------|---------------|---------------|---------------|---------------|-------------------------------|-------------|---------------------------|----------------|---------------|------------------------------|
| | | | | | | | | | | | | |
| | 15 Feb. '95 | 27 Jul. '95 | 4 Feb. '96 | 3 Jul. '97 | 2 Feb. '97 | 1 Jul. '97 | 10 Jan. '98 | 16 Jul. '94 | Depth range (m) | Chundo Is. '96 | Geoje Is. '98 | Tangsa (Present study) |
| <i>Styela plicata</i> | 1 | | | | | | 2 | | 4-6 | + | + | + |
| <i>Styela tokiokai</i> | 5 | | 6 | | 3 | | 1 | 12 | | | + | + |
| Pyuridae | | | | | | | | | | | | |
| <i>Boltenia echinata</i> | 1 | | | | | | | 6 | 10 | | + | + |
| ** <i>Boltenia transversaria</i> | 5 | | | | | | | | 9 | | | + |
| ** <i>Microcosmus multidentaculatus</i> | 1 | | | | | | | | 12 | | | + |
| <i>Pyura lepidoderma</i> | 3 | 1 | 3 | | | | | 3 | 3-10 | + | + | + |
| <i>Pyura saciformis</i> | 7 | 1 | 11 | 5 | 4 | | | 17 | 3-12 | + | + | + |
| ** <i>Pyura squamata</i> | | 1 | | | | | | 2 | 3 | | | + |
| <i>Pyura vittata</i> | 7 | | | | | | | 3 | 10 | | + | + |
| <i>Herdmania mirabilis</i> | 1 | | 3 | 1 | 1 | | | 2 | 10 | + | + | + |
| <i>Halocynthia hispidia</i> | 6 | | 3 | | 6 | | 3 | 28 | 4-7 | + | + | + |
| <i>Halocynthia roretzi</i> | 2 | | 5 | 1 | 6 | | 1 | 3 | 4-9 | + | + | + |
| * <i>Molgula hozawai</i> | | | | | | | | | | | | |
| <i>Molgula tectiformis</i> | 2 | | | | 1 | | | 2 | 10 | | | + |
| | | | | | | | | 1 | 10 | + | + | + |
| Total | 64 | 36 | 50 | 18 | 31 | 1 | 8 | 99 | | 12 | 23 | 30 |

1) Numbers are those of individuals (colonies) collected.

2) *: new to Korean ascidian fauna.

**: recorded for the first time from Korean warm waters.

Strait), Japan (Mutsu Bay), Australia (Western coast, Queensland, New South Wales), Indonesia, the Philippines.

RESULT

The specimens dealt with in this work were identified into 30 species. Out of them 29 ascidian species (97%) have been already recorded from Korean warm waters. Just one species, *Molgula hozowai*, turned out to be new to the Korean ascidian fauna. Six species are newly recorded in this area.

Two-thirdth (23 species) out of the 30 intertidal or very shallow waters species identified in this paper have been recorded from Geojedo Is. and its adjacent waters (Rho and Park, 1998). Twelve of them were also described from Chundo Is. warm waters (Rho, 1996) (see Table 1).

The ascidian fauna of Tangsa seems rather similar to that of the waters of Chundo Is. and Geojedo Is. Eleven species (37%) are found in common among these three localities, 12 ones (40%) are found in common in two localities (Tangsa and Geojedo Is.), and only one (3%), *Styela canopus*, is found in common in Tangsa and Chundo Is. warm waters. The similarity in the composition of species all these seems to come from the fact that these areas are located in the similar latitudes.

ACKNOWLEDGEMENTS

This study is supported partially by the Academic Research Fund of Ministry of Education, Republic of Korea (BSRI-94~99-4421) and also is supported partially by the Academic Research Fund of Korea Racing Association (1998, 1999).

We are deeply grateful to the scuba divers of the BSRI-94~99-4421 for their helps in the specimens collection.

REFERENCES

- Drasche, R. V., 1884. Über einige neue und weniger bekannte ausser-europäische einfache asciden. Denkschr. Akad. Wiss. Wien., **48**: 369-386.
- Hartmeyer, R., 1906. Ein beitrage zur kenntnis der japonischen ascidenfauna. Zool. Anz., **31**: 1-32.
- Hartmeyer, R., 1923. Ascidiacea, part 1. zugleich eine uebersicht über die arktische und boreale ascidenfauna auf tiergeographischer grundlage. Danish Ingolf-Exp., **2**(6): 1-368.
- Herdman, W. A., 1880. Preliminary report on the tunicata of the "Challenger" expedition, Proc. Roy. Soc., Edinburgh, Pt. 1. and Pt. 2., **10**: 458-472, 714-726.
- Herdman, W. A., 1881. Preliminary report on the tunicata of the "Challenger" expedition. Proc. Roy. Soc., Edinburgh, Pt. 3. Cynthiadae, **2**: 52-88.
- Huntman, A. G., 1912. Holosomatous ascidians from coast of Western Canada. Contr. Canad. Biol., Ottawa,

103-185.

- Kott, P., 1964. Stolidobranch and Phlebobranch ascidians of the Queensland Coast. Pap. Dep. Zool. Univ. Qd., **2**: 127-152.
- Kott, P., 1985. The Australian ascidacea, part 1. Phlebobranchia and Stolidobranchia. Mem. Qd. Mus., **23**: 1-440.
- Miller, R. H., 1975. Ascidians from the Indo-West-Pacific region on the zoological museum, Copenhagen (Tunicata, Ascidia). Steenstrupia, Zool. Mus. Univ., Copenhagen, **3**(20): 205-336.
- Nishikawa, T., 1981. Contribution to the Japanese ascidian fauna XXXV. *Molgula hozawai* Oka, 1932 and *M. verrucifera* Ritter and Forsyth, 1917, with special reference to the funnel-like structure within the siphon. Publ. Seto Mar. Biol. Lab., **26**: 337-345.
- Nishikawa, T., 1990. The ascidians of the Japan Sea I. Publ. Seto Mar. Biol. Lab., **34**(4-63): 73-148.
- Nishikawa, T., 1991. The ascidians of the Japan Sea II. Publ. Seto Mar. Biol. Lab., **35**(1-3): 25-170.
- Nishikawa, T., 1992. The ascidians of the Japan Sea III. Publ. Seto Mar. Biol. Lab., p. 305.
- Oka, A., 1927. Zur kenntnis der japonischen botryllidae. Proc. Imp. Acad. Japan, **3**: 607-609.
- Oka, A., 1932. Ueber eine neue *Molgula*-Art aus mutabai. Proc. Imp. Acad. Japan, **4**: 303-305.
- Oka, A., 1935. Report of biological survey of Mutsu bay 28. ascidian simplices. Sci. report of Tohoku Imp. Univ., 4th ser., Biology, **10**(3): 428-466.
- Redikrvez, R., 1927. Zehn neue ascidien aus dem fernen osten. Zool. Jahrb. Syst., **53**: 373-404.
- Rho, B. J., 1966. Taxonomic study on the prochordates from Korea 1. ascidians. J. Kor. Cult. Res. Inst., **8**: 209-216.
- Rho, B. J., 1971. A study on the classification and the distribution of the Korean ascidians. J. Kor. Res. Inst. Bet. Liv., **6**: 103-166.
- Rho, B. J., 1975. On the classification and the distribution of the marine benthic animals in Korea. 3. ascidians. J. Kor. Res. Inst. Bet. Liv., **15**: 121-169.
- Rho, B. J., 1995. The ascidians (Tunicata) from Chindo Island, Korea. Korean J. Syst. Zool., **11**(1): 125-145.
- Rho, B. J. and M. K. Huh, 1984. A systematic study on the ascidians in Korea. Kor. Res. Inst. Bet. Liv., **33**: 99-136 (in Korean).
- Rho, B. J., and J. E. Lee, 1989. A systematic study on the ascidians from Cheju Island, Korea. Korean J. Syst. Zool., **5**(1): 59-76.
- Rho, B. J. and J. E. Lee, 1991. A systematic study on the ascidians in Korea. Korean J. Syst. Zool., **7**(2): 195-220.
- Rho, B. J. and K. S. Park, 1998. Taxonomy of ascidians from Geojedo Island in Korea, Korean J. Syst. Zool., **14**(3): 173-192.
- Rho, B. J., B. L. Choe and J. I. Song, 1996. Biosystematic studies on the marine fouling invertebrates in Korea-A systematic study on the ascidians from Chundo Island (Onsan bay), Korea. Korean J. Syst. Zool., **12**(3): 221-235.
- Ritter, W. E. and R. A. Forsyth. 1917. Ascidians of the littoral zone of Southern California. Univ. Calif. publ. zool., **16**: 439-512.
- Savigny, J. C., 1816. Memoires sur les animaux sans vertebrate, part 2, fasc. 1, 260 pp. Paris.
- Sluiter, C. P., 1904. Die tunicaten der siboga-expedition. pt. 1. die sozialen und holosomen ascidian. Siboga-Exp., Mongr., **56a**: 1-126.
- Sluiter, E. P., 1885. Über einige einfachen ascidien von der insulin billiton. Nat. Tijdschr Ned. Ind., **45**: 160-

232. Savigny

- Sluiter, E. P., 1898 Beitrage zur kenntnis ler fauna von Sud-Africa. II. Tunicaten 18. Zool. Jahrb. Syst., **11**: 1-64.
- Stimpson, W., 1852. Several new ascidians from the coast of the United States. Proc. Boston Sac. Nat. Hist., **4**: 228-232.
- Tokioka, T., 1949a. Contribution to japanese ascidian fauna I. ascidians collected by Prof. Miyadi and Mr. Masui during the bottom survey 1939-40. Publ. Seto Mar. Biol. Lab., **1**(1): 1-17.
- Tokioka, T., 1949b. Contribution to japanese ascidian fauna II. notes on some ascidians collected chiefly along the coast of Kii Peninsula. Pulb. Seto Mar. Biol. Lab., **1**(2): 39-63.
- Tokioka, T., 1951. Contribution to the japanese ascidian fauna IV. notes on some ascidians collected in Osaka Bay (1). Publ. Seto Mar. Biol. Lab., **1**: 169-182.
- Tokioka, T., 1953. Ascidians of sagami bay. Pulb. Iwanami Shten, Tokyo, Japan, pp. 1-315.
- Van Name, W. G., 1945. The north and south American ascidians. Bill. Amer. Mus. Nat. Hist., **84**: 1-476.
- Verrill, A. E., 1871. Description of some imperfectly known and new ascidians from New England. Amer. J. Sci., Ser. 3, **1**: 54-58, 93-100, 211, 212, 288-294, 443-446.

RECEIVED: 7 December 1999

ACCEPTED: 15 February 2000

대한해협 의 당사 및 인근 수역 해초류의 분류

노 분 조 · 최 병 래* · 송 준 임 · 이 영 자

(이화여자대학교 생물과학과; *성균관대학교 생물학과)

요 약

1994년 7월부터 1999년 6월까지 대한해협 의 당사(堂舍) 및 인근 수역에서 본인과 연구팀에 의해 조간대와 잠수 및 SCUBA 잠수 등으로 수행되었다. 채집된 재료는 8과 17속 30종으로 동정 분류 되었고, 이 중 한 종, 주머니가죽멍게(*Molgula hozawai*)은 한국미기록 종이었으며, 그 외 29종은 당사 및 인근 수역에서는 처음으로 밝혀지는 종들이다. 이 지역 해초류의 생물지리학적 분포를 보면 30종 모두가 우리나라 천해종이며 난수역 종이다. 이들 중 23종은 거제도(巨濟島)에서 이미 보고된 종이고, 12종은 춘도(椿島)에서 보고되었으며, 6종, 일로툼멍게(*Eudistoma illotum*), 새공멍게(*Symplegma connectans*), 가로줄멍게(*Boltenia transversaria*), 우주멍게(*Microcosmus multitentaculatus*), 네모가죽멍게(*Pyura squamata*)와 주머니가죽빛멍게(*Molgula hozawai*)는 이들 3개 난수역 지역에서는 처음으로 보고된 종이다. 그리고 11종(37%)은 3개 지역에 공통으로 나타났고 12종(40%)은 당사와 거제도에 공통이며, 한 종(3%), 두줄미더덕(*Styela canopus*)은 당사와 춘도에서 공통종으로 나타났다. 따라서 당사 및 인근 수역의 해초류는 거제도와 춘도의 해초류상과 아주 유사하며 이는 이들 지역이 거의 같은 위도(북위 34° 40'–35° 22', 동위 128° 45'–129° 27')에 위치하고 있어 북상하는 따뜻한 쿠로시오 난류의 영향을 받기 때문으로 사료된다.